EUROPHOTONICS-POESII MASTER COURSE

PROPOSAL FOR A MASTER THESIS

Dates: April 1st, 2016 – September 30th, 2016

Laboratory: Institut de Ciencies Fotonique (ICFO)
City, Country: Barcelona, Spain

Title of the master thesis: Physical implementation of non-locality based quantum protocols.

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Summary of the subject (maximum 1 page):

Entanglement is one of the most striking predictions of quantum mechanics. It refers to strong correlations between different systems that cannot have any classical explanation. Perhaps the most counter-intuitive consequence of entanglement is the fact that the results of measurements applied in separated systems are non-locally connected. These non-local correlations are the ones leading to Bell inequality violations.

Entanglement is also the main ingredient behind several quantum information protocols, like quantum teleportation, quantum key distribution and super-dense coding. More recently a new type of quantum information protocols based on nonlocal correlations have been proposed and named device-independent quantum information protocols. Compared to the standard quantum information protocols, the device independent ones have the advantage of not relying on any description of the apparatuses used in the protocol. Loosely speaking we can perform device-independent protocols even without knowing anything about the inner working of the devices being used.

However, from the experimental point of view, to prove unambiguously the non-local character of quantum systems represents a tremendous challenge using current technology. In fact it was only recently (last August) that a complete experimental demonstration of non-locality was reported. The target of this proposal, is to bridge the gap between theory and

experiment by developing proposals of new experiments and analyzing the current quantum technologies enabling the introduction of new practical, and implementable quantum cryptography solutions that can be proven secure based on few realistic and testable assumptions about the devices.

Keywords : Quantum entanglement, Bell non-locality, device-independent quantum information protocols, implementations.

Additional information :
* Required skills : Quantum mechanics course
* Miscellaneous :